

15. Climate Change

Introduction

- 15.1 This Chapter reports the outcome of the assessment of likely significant environmental effects arising from the Project for Assessment in terms of greenhouse gas (GHG) emissions / savings and net GHG effect ('climate change mitigation').
- 15.2 The Chapter describes the scope of the assessment and assessment methodology, and a summary of the baseline information that has informed the assessment.
- 15.3 In line with **Chapter 2: Approach to EIA**, the assessment reports on the likely significant environmental effects including the further mitigation measures required to prevent, reduce or offset any significant adverse effects, or further enhance beneficial effects. The conclusions are provided in terms of whether the residual effects are considered to be significant. The assessment of effects takes into consideration both primary and tertiary mitigation (see **Chapter 2: Approach to EIA** for further details).
- 15.4 This Chapter, and its associated **Appendix 15.1: Carbon Calculator**, is intended to be read as part of the wider ES with particular reference to the introductory Chapters of this ES (**Chapters 1 – 5**).
- 15.5 Please note the terms 'carbon', 'carbon dioxide (CO₂)', 'carbon dioxide equivalence (CO₂e)' and 'greenhouse gas emissions (GHGs)' are used interchangeably to reflect the varied terminology of referenced documents. However, the Scottish Environmental Protection Agency (SEPA) Carbon Calculator for onshore windfarms on peatland¹ that has been employed largely reports emissions, savings and net GHG effect in terms of tonnes of CO₂ equivalent (tCO₂e) and as such includes all relevant Kyoto Protocol² GHGs, principally CO₂ and methane (CH₄).

Summary of Consultation

2025 ES

- 15.6 The Project Team undertook an EIA Scoping exercise (described further under the 'Scope of Assessment' section below) in support of the 2025 ES, which included consultation with RMBC and RBC and other stakeholders. The outcomes of this process are documented in **Chapter 2: Approach to EIA** and **Appendices 2.1 and 2.2**. No consultation has been undertaken over and above that completed during the EIA Scoping process.

2026 FEI ES

- 15.7 No further consultation has been undertaken as part of this ES. However, statutory consultation responses received following submission of the 2025 ES that are directly relevant to this ES, and its supporting material have been considered.

Scope of Assessment

- 15.8 An EIA Scoping Report was submitted to RMBC and RBC on 16th December 2024, as presented as **Appendix 2.1**. At the time of writing (May 2026), no Scoping Opinion has been

received. Therefore, the scope of assessment is the same as that submitted as part of the 2025 ES.

Effects Unlikely / Not Significant

15.9 The following effects were not considered significant as part of the EIA Scoping Report (**Appendix 2.1**) and are not considered further in this Chapter:

- Extreme weather impacts on turbine operation;
- Heat stress impacts on construction workers; and
- Increased risk of flooding (see in the drainage and flood risk assessment reports which accompanies the Application with further details on how these issues are addressed).

Effects Likely / Significant

15.10 **Table 15.1** outlines the effects that are considered likely / significant and are reported within this Chapter.

Table 15.1: Effects likely / significant

Likely significant effect	Receptor(s)	Applicable stage(s)
GHG emissions, GHG savings, and net GHG effect	Global climate system	Construction, operation and decommissioning

- 15.11 As explained in ‘Assessment Methodology’ below, the SEPA Carbon Calculator forecasts emissions across the full lifecycle of the Project for Assessment including construction, operation and decommissioning. However, the tool is designed to provide the ‘carbon payback period’, being the period of time (years) following the commencement of wind farm operation when total GHG emissions forecast across the construction, operational and decommissioning stages are balanced out by operational GHG savings. Because of this, construction and decommissioning stage GHG emissions are reported with construction stage GHG emissions and cannot easily be separated out.
- 15.12 Hence the GHG assessment reported in this Chapter and **Appendix 15.1** covers the full development lifecycle, however the results cannot be fully reported under each lifecycle stage (construction, operation and decommissioning). For this and other reasons set out below, the construction stage GHG emissions are considered worse-case.

Assessment Methodology

Legislative Framework, Policy and Guidance

15.13 The following legislation and policy has informed the assessment of effects within this Chapter:

International

- The Paris Agreement³ is a legally-binding international treaty on climate change which seeks to hold the increase in global average temperature to well below 2°C above pre-industrial levels.

National

- Paragraph 161 of the NPPF⁴ explains the planning system should support the transition to net zero by 2050, including the delivery of renewable and low carbon energy generation and associated infrastructure. Paragraph 168 states that, when determining planning applications for all forms of renewable and low carbon energy developments and associated infrastructure, local planning authorities should give significant weight to the benefits associated with renewable and low carbon energy generation and the proposal's contribution to a net zero future. On 16th December 2025, Government published a consultation on proposed reforms to the NPPF and other changes to the planning system together with a revised draft NPPF⁵. One key proposed change relates to renewable and low carbon energy development and electricity network infrastructure ('W3') where "substantial" weight (currently "significant" weight) should be given to the benefits of such developments by local planning authorities in decision-making, including supporting the transition to net zero;
- The Climate Change Act (2008)⁶ as amended⁷ sets a legally-binding target for the UK to reduce GHG emissions to net zero by 2050, the world's first major economy to do so. The Act requires Government to set legally-binding 'carbon budgets' to act as stepping-stones towards the 2050 target, establishing a cap on the amount of GHGs emitted over a five-year period. Seven carbon budgets have been implemented in law to date and run up to 2042, requiring GHG emissions to be reduced by at least 87% by 2037 to 2042, relative to 1990 levels; and
- The Clean Power 2030 Action Plan⁸ accepts the independent advice from the National Energy System Operator (NESO) regarding the energy infrastructure required to deliver Clean Power 2030 and achieve Government's ambition for between 27 and 29 gigawatts (GW) of new onshore wind capacity by 2030, compared with 18.6 GW onshore wind capacity that is currently installed, committed to, or under construction.

Greater Manchester

- The Greater Manchester Five Year Environment Plan 2025-2030⁹ explains that Greater Manchester declared a climate emergency in 2019 and set a target to become a carbon neutral city region by 2038. The Plan identifies increasing the capacity of large-scale renewable energy generation, including onshore wind, as a key opportunity in support of this ambition; and
- The Places for Everyone Joint Development Plan 2022-2039 (2024)¹⁰ is the strategic spatial plan setting out the planning policy framework for nine Greater Manchester boroughs (including Rochdale) to achieve sustainable and inclusive growth. The Plan seeks to support Greater Manchester's ambition to be a carbon neutral city region by 2038, with Plan Objective 7 – 'Playing our part in ensuring that Greater Manchester is a more resilient and carbon neutral city-region' including increasing the generation of renewable and low carbon energy.

Local Authority

- RMBC's Climate Change Strategy and Delivery Plan 2021-2025 (2022)¹¹ explains the Council declared a climate emergency in 2019 and has set the ambition to become a

carbon neutral borough by 2038, including a target to significantly increase renewable electricity generation within the borough; and

- RBC's Climate Change Strategy 2020-2030 (2020)¹² explains the Council also declared a climate emergency in 2019 and has committed to urgent actions, with the generation of more renewable energy identified as key to tackling climate change.

15.14 The following guidance has informed the assessment of effects within this Chapter:

- Assessing Greenhouse Gas Emissions and Evaluating their Significance; Edition 2.1 (ISEP, 2026)¹³ ('ISEP GHG Guidance').

Defining the Study Area

15.15 The GHG assessment considers emissions and savings from a wide range of sources and activities across the construction, operation and decommissioning stages of the Project for Assessment. These sources and activities include: wind farm components production, transport, operation and decommissioning; back-up generation; effects on bog plants and soil organic carbon; changes to drainage conditions; carbon benefits from peatland restoration, and; reduced demand for fossil-fuel generated electricity on the national grid once the Project for Assessment becomes operational.

15.16 As such the assessment covers GHG emissions and savings that will occur within the Assessment Boundary (e.g. GHG emissions from peat excavation during construction, and GHG savings from the proposed peat restoration), as well as GHG emissions and savings that will occur outside the Assessment Boundary (e.g. GHG emissions from turbine manufacture, and GHG savings from reduced reliance on fossil fuels). It is not currently possible to forecast specifically where these GHG emissions and savings beyond the Assessment Boundary will occur.

Background Studies to Inform the ES

15.17 **Table 15.2** summarises all studies / surveys / analysis / evaluations undertaken to inform the assessment presented within this Chapter.

Table 15.2: Studies / surveys / evaluations / analysis undertaken to inform the ES

Study / survey / analysis / evaluation	Overview	Date of completion
Carbon Calculator Input Data & Results (Appendix 15.1)	Application by Turley Sustainability & ESG of the SEPA Carbon Calculator for Windfarms on Scottish Peatlands tool to quantify GHG emissions, GHG savings, and the net GHG effect including the 'carbon payback period' for the Project for Assessment (see further detail in 'Assessment Process' below).	May 2026

Assessment Process

15.18 The ISEP GHG Guidance explains that GHG quantification for EIA should follow the principles set out in guidance such as the Greenhouse Gas Protocol Corporate Accounting and Reporting Standard¹⁴ in terms of the assessment being relevant, complete, consistent,

transparent and accurate. The Standard goes on to explain that GHG assessments for EIA should seek to quantify the difference in GHG emissions between the Project for Assessment and the baseline scenario (e.g. no development) and reflect the difference in whole life net GHG emissions between these two scenarios. The assessment should include all ‘material’ emissions, both direct and indirect, across the whole life of the proposed project, with the assessment boundary clearly defined and aligned with best practice. The assessment should seek to present a reasonable worst case, with any exclusions, limitations, assumptions or uncertainties justified and reported as appropriate.

- 15.19 The ISEP GHG Guidance further explains that the crux of whether a project’s GHG effect is significant or not is whether it emits GHG emissions, nor even the magnitude of GHG emissions alone, but whether it contributes to reducing GHG emissions in line with a science-based net zero trajectory. The specific context for an individual project and the contribution it makes should be established through the professional judgement of an appropriately qualified practitioner, drawing on the available guidance, policy and scientific evidence.
- 15.20 Quantifying GHG emissions, savings and net GHG effect of an onshore windfarm on peatland across its lifecycle is complex due to the various factors concerned. However, a readily-applicable and mature methodology exists in the form of SEPA’s Carbon Calculator tool. Originally developed by the University of Aberdeen in a 2008 research report *Calculating carbon savings from wind farms on Scottish peat lands: a new approach* (Nayak et al, 2008)¹⁵, the tool was further refined on the basis of feedback and further research (Nayak et al., 2010)¹⁶ (Smith et al., 2011)¹⁷, under the guidance of a steering group with membership including Scottish Government, SEPA, Scottish Natural Heritage (SNH), and Forest Research.
- 15.21 Application of the SEPA Carbon Calculator tool is considered appropriate for the following reasons:
- The tool was created in academia and further developed under the steerage of various statutory bodies ensuring it is rooted in science;
 - It has been applied successfully to many onshore windfarm projects since its development, and as such represents a significantly more objective approach than could be achieved if the Applicant were to seek to develop their own bespoke methodology;
 - The tool quantifies carbon emissions, savings and net GHG effect across the full project lifecycle, and establishes the ‘carbon payback period’, being the period of time after the start of project operation at which forecast GHG emissions during construction, operation and decommissioning are balanced out by operational GHG savings, an approach aligned with the ISEP GHG Guidance;
 - Although developed for onshore windfarms on Scottish peatlands, the tool utilises input data that is specific to the scheme and the site in question (e.g. peat type, depth, dry bulk density, drainage conditions, average air temperature, scheme design, site restoration, etc.) as well as published benchmarks where such data is not available, and as such is considered to be readily applicable to onshore windfarm proposals on peatland in other parts of the UK. Examples of consented wind farms that have applied the SEPA Carbon Calculator outside of Scotland include Upper Ogmere Wind Farm, Bridgend, Wales¹⁸, and Garn Fach Wind Farm, Newtown, Wales¹⁹; and

- Scottish Government's NPF4 Planning Guidance; Policy 2 Climate Mitigation and Adaptation (June 2025)²⁰ states (paragraph 4.7.3, p26) that the Scottish Government's Peatland Carbon Calculator Tool for windfarms on peatland as applied in this Chapter can be used to support the consideration of peatland and its incorporation in a lifecycle GHG assessment. This document recognises the calculator has been subject to a recent review by ClimateXChange, *"...but currently remains the best available means by which carbon calculations can be provided in a consistent and comparable format, until such a time as there is an alternative or replacement of the calculator"*.

15.22 The assessment process therefore comprises:

- Reviewing the Project for Assessment (plans, reports, specification etc);
- Establishing its context in terms of planning policy and related guidance for renewable energy generation, electricity grid decarbonisation and net zero at the UK, Greater Manchester and local authority (RBC and RMBC) levels;
- Establishing baseline conditions in relation to GHG emissions at various geographic scales (Assessment Boundary, RBC, RMBC, North West England, England and UK) and currently installed onshore wind generation capacity within RBC and RMBC;
- Establishing future carbon budgets set for the UK and published for RBC and RMBC;
- Establishing the sensitivity of the receptor (the global climatic system) to GHG effects;
- Liaising with the Applicant and project team specialists (i.e. peat, ecology, hydrology and engineering) to obtain appropriate input data for the Carbon Calculator tool as set out in **Appendix 15.1**;
- Completing the Carbon Calculator tool and preparing an Appendix to the ES (**Appendix 15.1**) to report the input data, assumptions and results including forecast GHG emissions, savings and carbon payback period;
- Reporting the Carbon Calculator tool results in the context of baseline GHG emissions and future carbon budgets to establish the magnitude of GHG effect;
- Establishing the contribution of the Project for Assessment to a net zero trajectory at the RBC, RMBC and UK level, as required by the ISEP GHG Guidance to determine the level and significance of GHG effect. This comprises evaluating its operational GHG effect in the context of baseline GHG emissions, future carbon budgets, and its contribution to currently installed wind energy generation capacity, together with professional judgement;
- Establishing the need for / evaluate any measures that are proposed to mitigate adverse effects and / or enhance beneficial effects; and
- Conclude on the significance of construction stage GHG emissions, operational zero carbon electricity supply and GHG emissions savings, and overall net GHG effect and payback period.

- 15.23 Worse-case assumptions include that each turbine will be rated at 5.7 megawatts (MW) whereas turbine power ratings up to 6 or 7 MW are being considered, and the exclusion of carbon sequestration that will be achieved by the 6.8 ha of new upland woodland planting that is proposed.

Reporting of the Environmental Effect and Significance Criteria

- 15.24 The assessment of likely significant environmental effects as a result of the Project for Assessment has taken into account the construction, operational and decommissioning stages. The following sections define the approach adopted within the assessment for the determination of sensitivity of receptor, magnitude of change, the level of effect and significance.

Determining the Sensitivity of Receptor

- 15.25 The sensitivity of affected receptors has been considered on a scale of **high, medium, low** or **negligible**. The receptor for GHG emissions is the global climate system, which is an interactive system comprising five components: the atmosphere, the hydrosphere, the cryosphere, the land surface and the biosphere²¹. The system is highly sensitivity to additional GHG emissions given the severe consequences of global climate change, the cumulative contributions of all GHG emission sources, and the significant climate change effects already being felt²². On this basis, the global climate system is considered to be a receptor of **high** sensitivity to additional GHG emissions.

Determining the Magnitude of Change

- 15.26 The magnitude of GHG effect has been considered as the net change in GHG emissions and savings resulting from the construction, operation and decommissioning of the Project for Assessment, and also overall net GHG effect, relative to baseline emissions at various geographical scales and also to future carbon budgets, and on a scale of **large, medium, small** or **negligible**.
- 15.27 Of these geographical scales, the combined baseline emissions and future carbon budgets proposed for the RBC and RMBC administrative areas is considered the most appropriate basis on which the magnitude of net GHG change should be based.
- 15.28 There are currently no agreed thresholds for determining the magnitude of change of GHG emissions in EIA. This assessment has therefore applied the percentage change thresholds presented in **Table 15.3** which have been developed by Turley drawing from the ISEP GHG Guidance and professional judgement.

Table 15.3: Determining the magnitude of change

Magnitude of change	Description of change
Large	A large increase / decrease in GHG emissions (e.g. >10%) relative to baseline local / regional / national emissions and/or future carbon budgets and / or sectoral decarbonisation pathway
Medium	A moderate increase / decrease in GHG emissions (e.g. 5% to <10%) relative to baseline local / regional / national emissions and/or future carbon budgets and / or sectoral decarbonisation pathway

Magnitude of change	Description of change
Small	A small increase / decrease in GHG emissions (e.g. 1% to <5%) relative to baseline local / regional / national emissions and/or future carbon budgets and / or sectoral decarbonisation pathway
Negligible	A negligible increase / decrease in GHG emissions (e.g. <1%) relative to baseline local / regional / national emissions and/or future carbon budgets and / or sectoral decarbonisation pathway

Determining the Level of Effect

15.29 Where applicable, the level of effect has been informed by the magnitude of change due to the Project for Assessment and the evaluation of the sensitivity of the affected receptor. The level of effect, where used, has been determined using professional judgement and **Table 15.4** has been a tool which has assisted with this process.

Table 15.4: Matrix to support determining the level of effect

		Sensitivity of receptor			
		High	Medium	Low	Negligible
Magnitude of change	Large	Major	Moderate to Major	Minor to Moderate	Negligible
	Medium	Moderate to Major	Moderate	Minor	Negligible
	Small	Minor to Moderate	Minor	Negligible to Minor	Negligible
	Negligible	Negligible	Negligible	Negligible	Negligible

15.30 Whilst this matrix provides ranges, where used, the level of effect is confirmed as a single level and not a range, informed by professional judgement.

15.31 Drawing from the ISEP GHG Guidance, the following terms are used to define the significance of net GHG effect:

- **Major adverse:** Where mitigation measures of the project are not in line with a science-based 1.5°C aligned transition to net zero for that project type, and net GHG emissions equate to a large increase (e.g. ≥10%) relative to baseline local/national emissions, future carbon budgets or sector decarbonisation pathway. A project with major adverse effects locks in emissions and does not make a meaningful contribution to a net zero trajectory zero;
- **Moderate adverse:** Where mitigation measures of the project are partially in line with a science-based 1.5°C aligned transition to net zero for that project type, and net GHG emissions equate to a medium increase (e.g. 5% to 10%) relative to baseline local/national emissions, future carbon budgets or sector decarbonisation pathway. A project with moderate adverse effects complies with some up-to-date policy and good

practice but is locking in some emissions and makes only a partial contribution to a net zero trajectory;

- **Minor adverse:** Where mitigation measures of the project are in line with a science-based 1.5°C aligned transition to net zero for that project type, and net GHG emissions equate to a small increase (e.g. <5%) relative to baseline local/national emissions, future carbon budgets or sector decarbonisation pathway. A project with minor adverse effects complies with up-to-date policy and good practice reduction measures and makes a contribution to a net zero trajectory;
- **Negligible:** Mitigation measures of the project are fully in line with a science-based 1.5°C aligned transition to net zero for that project type, with minimal residual emissions (e.g. net zero). A project with negligible effects complies with up-to-date policy and best practice and plays a full part in achieving the rate of net zero transition required by nationally set policy; and
- **Beneficial:** The project's net GHG impacts are below zero and result in a reduction in atmospheric GHG concentration, whether directly or indirectly, compared to the baseline. A project with beneficial effects substantially exceeds net zero requirements with a positive climate impact.

15.32 The ISEP GHG Guidance recognises that 'minor adverse' effect or better is a high bar which indicates exemplary performance where a project meets or exceeds measures to achieve net zero earlier than 2050. However, in the context of the severe threat of climate change, such an effect cannot be judged as significant beneficial – this category is reserved for projects with net GHG effects that directly or indirectly remove or avoid GHG emissions relative to the 'without-project' baseline.

15.33 The ISEP GHG Guidance does not differentiate between different levels within the 'Beneficial' category (i.e. minor beneficial, moderate beneficial, major beneficial). However, given the new v2.1 ISEP GHG Guidance advises that the magnitude, level and significance of GHG effect should be concluded for each project stage where possible as well as for the net GHG effect, this assessment has concluded on different levels of beneficial effect (i.e. minor, moderate and major beneficial) by applying the percentage thresholds from **Table 15.3** to forecast GHG savings as well as to GHG emissions. This ensures that GHG emissions and savings across the Project for Assessment's lifecycle stages are considered on the same basis.

15.34 The duration of GHG effect has been considered as either short-term (i.e. 0 to 5 years), medium-term (i.e. 5 to 15 years) or long-term (i.e. more than 15 years). Once released to the atmosphere, carbon dioxide (CO₂), the principal GHG, is long-lived (between 300 and 1,000 years)²³, and as a result the GHG effect is considered to be **long-term**.

Determining Significance

15.35 A statement has been made as to whether the effect is '**Significant**' or '**Not Significant**'. In line with the ISEP GHG Guidance, major adverse, moderate adverse and all beneficial effects are considered to be '**Significant**', whilst minor adverse and negligible effects are considered to be '**Not Significant**'. Significance is only concluded for the net and residual effects (i.e. following the consideration of any secondary mitigation).

Baseline Conditions

- 15.36 Baseline GHG emissions for the most recent period (2023 calendar year) have been obtained from UK local authority and regional greenhouse gas emissions statistics²⁴ for the RBC and RMBC administrative areas (both separately and totalled together), North West England, England and UK, as presented in **Table 15.5**. Total baseline GHG emissions from the RBC and RMBC administrative areas (1,297,183 tCO₂e) is considered the most appropriate geographical scale for the evaluation of the magnitude of change in GHG emissions.

Table 15.5: Baseline GHG emissions

Geographical area	Baseline GHG emissions (tCO ₂ e)
RBC	425,365
RMBC	871,819
RBC + RMBC	1,297,183
North West England	38,976,983
England	275,589,266
UK	356,094,108

- 15.37 **Table 15.6** presents currently installed onshore wind energy generation capacity within RMBC and RBC as at the end of 2024²⁵.

Table 15.6: Current Onshore Wind Energy Generation Capacity

Geographical area	Wind Energy Generation Capacity (MW)
RBC	114.3
RMBC	1.3
Total 115.6	

- 15.38 Regarding baseline conditions in respect of GHG emissions within the Assessment Boundary, less than 13% of peatland in England is considered to be in a near natural state which stores rather than emits carbon²⁶, and even in an undisturbed state, peatlands emit the GHG methane whilst accumulating carbon derived from the atmosphere²⁷. As noted in **Chapter 9: Ecology**, the main habitat within the Assessment Boundary is highly degraded blanket bog, with signs of historic burning and drainage in all areas, and with the blanket bog species communities being highly eroded and species-poor. It is therefore considered likely that significant GHG emissions occur on-site from the degraded peatland in the baseline scenario.
- 15.39 It is however highly challenging to estimate these baseline GHG emissions from degraded peatland within the Assessment Boundary with any accuracy. For the purposes of the GHG assessment therefore, baseline GHG emissions that occur from within the Assessment Boundary are assumed to be zero. This assumption will contribute to a worse-case approach by discounting any such baseline emissions prior to their reduction as part of the Project for Assessment.

Future Baseline

- 15.40 The University of Manchester's Tyndall Centre published carbon budgets from the energy system only for RBC²⁸ and RMBC²⁹ which are derived from the commitments enshrined in the Paris Agreement and informed by the latest climate change science. These carbon budgets are effectively therefore a future baseline of energy-related GHG emissions necessary to achieve net zero by 2050.
- 15.41 At the UK level, it is the duty of the Secretary of State to set for each succeeding period of five years (beginning with the period 2008 to 2012) an amount for the net UK carbon account (the 'carbon budget') and to ensure the net quantity of emissions does not exceed the carbon budget. Unlike the carbon budgets proposed for RBC and RMBC which relate to the energy system only, UK carbon budgets relate to all sectors of the economy with the exception of international aviation and shipping.
- 15.42 **Table 15.7** presents future carbon budgets proposed for RBC and RMBC, as well as those set in law for the UK. These figures are total GHG emission limits within each 5-year carbon budget period.

Table 15.7: Carbon budgets (tCO₂e)

Period	RBC*	RMBC*	UK
2028 – 2032	400,000	1,000,000	1,725,000,000
2033 – 2037	200,000	500,000	965,000,000
2038 – 2042	100,000	300,000	535,000,000
2043 – 2047	100,000	100,000	Not yet set
2048 – 2100	100,000	100,000	

** Emissions relating to the energy system only*

- 15.43 In the absence of the Project for Assessment and its associated peatland restoration work, the likelihood is that baseline GHG emissions from the degraded peat would continue and potentially increase over time.

Primary and Tertiary Mitigation

- 15.44 The core purpose and function of the Project for Assessment (i.e. a wind farm) is to reduce GHG emissions by exporting renewable zero carbon electricity to the national grid, thereby reducing demand for fossil fuel electricity generation (gas) and associated GHG emissions elsewhere. Nevertheless, careful consideration has been given to minimising GHG emissions during construction and maximising GHG savings during operation, as described below.

Construction Stage

- 15.45 The following primary and tertiary construction stage mitigation has been accounted for within the GHG assessment:

- Avoiding areas of peat greater than 1m in depth, where possible;

- The use and upgrade of approximately 4,884 m of existing track;
- The construction of approximately 752 m of floating track across areas of deep peat (>1m);
- The implementation of an Outline Peat Management Plan (**Appendix 14.3**) that details the volumes of peat to be excavated; how and where the peat could be excavated, stored, translocated and managed; and defining how eroded or degraded peat would be restored and necessary management processes; and
- The implementation of the **Moorland Restoration and Management Plan** (summarised as part of **Chapter 4: Development Specification**) to enhance existing habitats and providing a net gain in irreplaceable habitats whilst having wider benefits such as enhancing climate resilience.

Operational Stage

15.46 The following operational stage primary and tertiary mitigation has been accounted for within the GHG assessment:

- The wind turbine specification and output as detailed in **Chapter 4: Development Specification** including: a total of 12 turbines; an output of up to 84 MW (68.4 MW output is assessed in this Chapter on the reasonable worse-case assumption that each turbine has a power rating of 5.7 MW).

Assessment of Effects, Secondary Mitigation and Residual Effects

15.47 The following sections evaluate the forecast magnitude of change in GHG emissions during construction and operation of the Project for Assessment, as well as the magnitude of change, level and significance of the net GHG effect in line with ISEP GHG Guidance.

15.48 Please refer to the Carbon Calculator (**Appendix 15.1**): for details of all input data and assumptions etc to the carbon calculator tool, as well as the forecast GHG emissions, savings, net GHG effect and carbon payback period forecast for the Project for Assessment.

Construction Stage – GHG Emissions

15.49 **Table 15.8** presents total GHG emissions forecast from the Project for Assessment. Whilst some of these emissions will occur after construction, for example emissions from back up generation once the Project for Assessment becomes operational, and also during decommissioning, the large majority relate to the construction stage. For the purposes of this assessment as a worse-case, all such emissions are assumed to occur during construction which is scheduled to take 2 years. To facilitate comparison with the baseline GHG emissions reported in **Table 15.5**, estimated annual GHG emissions are also presented.

Table 15.8: Construction stage GHG emissions

GHG emissions source	GHG emissions (tCO ₂ e)		
	Expected	Minimum	Maximum
Turbine life (e.g. manufacture, construction & decommissioning)	58,299	58,299	58,299
Back-up	53,714	53,714	53,714
Reduced carbon fixing potential	2,586	800	7,879
Soil organic matter	21,776	7,198	24,382
Dissolved Organic Carbon (DOC) and percentage of total gaseous loss of carbon that is leached as DOC (POC) leaching	2,521	0	12,099
Felling of forestry	0	0	0
Total	138,896	120,011	156,373
Annual (2-year construction period)	69,448	60,006	78,187

- 15.50 In summary, the total GHG losses from the Project for Assessment of 138,896 tCO₂e, 120,006 tCO₂e, and 156,373 tCO₂e are forecast for the ‘expected’, ‘minimum’ and ‘maximum’ scenarios respectively, equating to annual emissions of 69,448 tCO₂e, 60,006 tCO₂e and 78,187 tCO₂e respectively based on the scheduled 2-year construction period.
- 15.51 **Table 15.9** presents the above maximum annual construction GHG emissions that are forecast in the context of combined baseline RBC and RMBC GHG emissions set out in **Table 15.5**. In addition to incorporating operational GHG emissions (back-up) and decommissioning emissions (turbine life), these emissions are worse-case in relation to construction stage emissions given the assumption inherent in the Carbon Calculator tool that 100% of carbon present in excavated peat is lost to the atmosphere.

Table 15.9: Construction stage GHG emissions in Context

Parameter	Value
Maximum annual construction GHG emissions	78,187 tCO ₂ e
As a % of baseline RBC GHG emissions	18.4%
As a % of baseline RMBC GHG emissions	9.0%
As a % of baseline RBC + RMBC GHG emissions	6.0%
As a % of baseline NW England GHG emissions	0.20%
As a % of baseline England GHG emissions	0.03%
As a % of baseline UK GHG emissions	0.02%

- 15.52 As explained above, combined baseline GHG emissions from the RBC and RMBC administrative areas is considered the most appropriate geographical scale for the evaluation of the magnitude of change in GHG emissions. Comparison against baseline GHG emissions at the other geographical scales is provided for further context.
- 15.53 The majority of construction stage GHG emissions are likely to relate to the manufacture and transport of the various wind farm components (turbines, cables, foundations, access tracks etc), a proportion of which are likely to be sourced from outside the UK given the global nature of the renewable energy market, and as a result construction stage GHG emissions are likely to have more limited implications to GHG emissions, carbon budgets and net zero at the RBC, RMBC, England and UK levels relative to GHG savings that will be delivered by the operation of the Project for Assessment within the national grid.
- 15.54 No significant GHG emission mitigation has been assumed in relation to construction stage GHG emissions. Given the nature of the Project for Assessment key GHG emissions mitigation is inherent its operation (see Operational Stage below). A moderate adverse GHG effect is therefore concluded for construction stage GHG emissions which reflects this lack of assumed mitigation and not solely the magnitude of forecast GHG emissions.
- 15.55 The sensitivity of the global climate system is considered to be high, and the magnitude of change at the combined baseline RBC + RMBC level (considered most appropriate for the evaluation of the magnitude of change) is a medium increase (i.e. between 5% and 10%), indicating a "moderate to major" adverse effect. Therefore, there is likely to be a direct, temporary, short-term, adverse residual effect which is considered to be moderate.
- 15.56 Application of micro-siting allowance has the potential to affect some of the input data to the SEPA Carbon Calculator as set out in **Appendix 15.1** (e.g. average peat depth at turbine foundations, hardstanding areas, access tracks and cable trenches etc), however such effects are likely to be limited and would not change the residual level of effect reported above.

Secondary mitigation or enhancement

- 15.57 No secondary mitigation or enhancement has been assumed.

Residual effect

- 15.58 In the absence of secondary mitigation, the residual effect is the same as that reported above in the pre-mitigation scenario.

Significance

- 15.59 The effect is considered to be **Significant**.

Operational Stage – GHG Savings

- 15.60 **Table 15.10** presents annual GHG savings forecast during operation of the Project for Assessment relative to the fossil fuel grid mix of electricity generation, and from proposed peatland improvement within the Assessment Boundary. Negative values represent GHG emissions savings.

Table 15.10: Operational stage GHG savings

GHG savings source	GHG emissions (tCO ₂ e)		
	Expected	Minimum	Maximum
Windfarm CO ₂ emissions relative to fossil fuel grid mix of electricity generation (tCO ₂ /year)	-102,326	-102,326	-102,326
Total CO₂ emissions due to improvement of the Assessment Boundary (tCO₂e)			
Improvement of degraded bogs	0	0	-29,267
Improvement of felled forestry	0	0	0
Restoration of peat from borrow pits	0	0	0
Removal of drainage from foundations & hardstanding	-3,446	0	-8,776
Total	-3,446	0	-38,033

- 15.61 In summary, total GHG savings from Assessment Boundary improvement of -3,446 tCO₂e, 0 tCO₂e, and -38,033 tCO₂e are forecast for the 'expected', 'minimum' and 'maximum' assessment scenarios respectively. Annual GHG savings of -102,326 tCO₂e are also forecast from the operation of the Project for Assessment relative to the fossil fuel grid mix of electricity generation. **Table 15.11** reports these forecast operational GHG savings relative to the fossil fuel grid mix in the context of the combined baseline RBC + RMBC GHG emissions set out in **Table 15.5**.

Table 15.11: Operational stage GHG savings in context

Parameter	Value
Annual operational GHG emissions vs fossil fuel grid mix	-102,326 tCO ₂ e
As a % of baseline RBC GHG emissions	-24.06%
As a % of baseline RMBC GHG emissions	-11.74%
As a % of baseline RBC + RMBC GHG emissions	-7.89%
As a % of baseline NW England GHG emissions	-0.26%
As a % of baseline England GHG emissions	-0.04%
As a % of baseline UK GHG emissions	-0.03%

- 15.62 As explained above, combined baseline GHG emissions from the RBC and RMBC administrative areas is considered the most appropriate geographical scale for the evaluation of the magnitude of change in GHG emissions. Comparison against baseline GHG emissions at the other geographical scales is provided for further context.
- 15.63 The sensitivity of the global climate system is considered to be high, and the magnitude of annual change at the combined baseline RBC + RMBC level is a medium decrease (i.e.

between 5% and 10%) indicating a “moderate to major” beneficial effect. A moderate annual beneficial GHG effect is therefore concluded as a worse-case. Therefore, there is likely to be an indirect, permanent, long-term beneficial residual effect which is considered to be moderate.

- 15.64 Application of micrositing allowance has the potential to affect some of the input data to the SEPA Carbon Calculator as set out in **Appendix 15.1** (e.g. turbine capacity factor), however such effects are likely to be limited and would not change the residual level of effect reported above.

Secondary mitigation or enhancement

- 15.65 No secondary mitigation or enhancement is required or has been identified.

Residual effect

- 15.66 In the absence of secondary mitigation, the residual effect is the same as that reported above in the pre-mitigation scenario.

Significance

- 15.67 This effect is considered to be **Significant**.

Decommissioning Stage

- 15.68 As explained above, the SEPA Carbon Calculator includes GHG emissions during decommissioning, however these are combined with GHG emissions during construction and operation to enable the carbon payback period to be derived, being the period of time (years) after the commencement of wind farm operation at which GHG emissions during construction, operation and decommissioning are balanced out by operational GHG savings. As such GHG effect from decommissioning of the Project for Assessment are explicitly considered but cannot readily be separated out.

Construction, operational and decommissioning stages GHG emissions and savings in-combination (i.e. Net GHG effect)

- 15.69 **Table 15.12** presents GHG emissions and savings forecast from the construction, operation and decommissioning of the Project for Assessment. Annual RBC, RMBC and UK carbon budgets have been estimated by Turley by dividing the 5-year carbon budget emissions presented in **Table 15.6** by 5, that is assuming an equal split of emissions within each budget across its 5 years. Negative values represent emissions savings, and the table cell shaded green highlights the year in which carbon payback is forecast i.e. the point at which operational GHG savings balance out GHG emissions forecast from construction, operation and decommissioning (which are all assumed to occur during construction).

Table 15.12: Construction, operational and decommissioning stage GHG emissions and savings (net GHG effect, tCO₂e) in context, including carbon payback period

Year	2028	2029	2030	2031	2032	2033	2034	2035	2036	2037
Project stage	Construction -->		Operation -->							
Construction GHGs	78,187	78,187	--	--	--	--	--	--	--	--
Operational GHGs	--	--	-102,326	-102,326	-102,326	-102,326	-102,326	-102,326	-102,326	-102,326
Net GHGs	78,187	78,187	-102,326	-102,326	-102,326	-102,326	-102,326	-102,326	-102,326	-102,326
Cumulative net GHGs	78,187	156,373	54,087	-48,279 ⁽²⁾	-150,605	-252,931	-355,257	-457,583	-559,909	-662,235
RBC + RMBC annual carbon budget	280,000	280,000	280,000	280,000	280,000	140,000	140,000	140,000	140,000	140,000
Net GHGs as % of RBC + RMBC annual carbon budget	27.92%	27.92%	-36.55%	-36.55%	-36.55%	-73.09%	-73.09%	-73.09%	-73.09%	-73.09%
UK annual carbon budget	345,000k	345,000k	345,000k	345,000k	345,000k	193,000k	193,000k	193,000k	193,000k	193,000k
Net GHGs as % of UK annual carbon budget	0.02%	0.02%	-0.03%	-0.03%	-0.03%	-0.05%	-0.05%	-0.05%	-0.05%	-0.05%

Notes

⁽¹⁾ Assumes steady-state fossil fuel electricity generation mix on the national grid

⁽²⁾ Forecast maximum (worse case) carbon payback period against the fossil fuel grid mix is 1.5 years (18.3 months) after the Project for Assessment becomes operational

- 15.70 In summary, forecast annual construction stage GHG emissions (78,187 tCO₂e) equate to circa 27.92% of estimated annual combined carbon budgets for RBC and RMBC for 2028 and 2029, or 0.02% of estimated annual UK carbon budgets for these years. As noted above, this figure includes emissions that will occur during operation (from back up) and decommissioning (from turbine life) and the assumption that all carbon present within excavated peat is lost to the atmosphere so is worse-case. It should also be borne in mind the RBC and RMBC carbon budgets relate to emissions from the energy system only.
- 15.71 Once the Project for Assessment becomes operational in 2030, annual GHG emissions of -102,326 tCO₂e (i.e. GHG savings) are forecast relative to the fossil fuel grid mix of electricity generation. These annual GHG savings from the operation of the Project for Assessment equate to circa -36.55% of the estimated annual combined RBC and RMBC carbon budgets up to 2032, increasing to -73.09% for the period 2033 to 2037. Regarding estimated annual UK carbon budgets, forecast annual operational GHG savings equate to -0.03% up to 2032, increasing to -0.05% for the period 2033 to 2037.
- 15.72 Based on the forecast construction stage GHG emissions and operational stage GHG savings, a maximum (i.e. worse-case) carbon payback period of 1.5 years (18.3 months) is forecast, with net GHG savings (i.e. negative emissions) accumulating over subsequent years. As such the forecast carbon payback period equates to just 3.8% of the Project for Assessment's 40-year operational period for which planning consent is sought.
- 15.73 It is acknowledged that GHG savings achieved by the Project for Assessment in future years will be dependent on the 'counterfactual' fossil fuel grid electricity generation mix at that time. However the Project for Assessment is forecast by the Carbon Calculator tool to generate some 9,131,564 megawatt hours (MWh) of zero carbon electricity over its lifetime, sufficient to power 84,552 typical UK homes each year (based on a typical UK home consuming 2,700 kWh of electricity each year³⁰), equivalent to circa 64.9% of the total number of households (130,240) in RBC (32,770) and RMBC (97,470) combined³¹.
- 15.74 With an assessed total generation capacity of 68.4 MW, the Project for Assessment represents an increase of 59.2% in currently installed wind energy generation capacity across the combined RBC and RMBC administrative areas (115.6 MW), further demonstrating its contribution to a net zero transition.
- 15.75 As such the Project for Assessment will continue to contribute to RMBC, RBC and UK net zero even following full decarbonisation of the national electricity grid.
- 15.76 The sensitivity of the global climate system is considered to be high, and the magnitude of change at the combined RBC + RMBC carbon budget level (considered most appropriate for the evaluation of the magnitude of change) is a large decrease (i.e. >10%). Therefore, there is likely to be a direct, permanent, long-term net GHG effect which is considered to be major beneficial. The Project for Assessment's net GHG effect is below zero and results in a reduction in atmospheric GHG concentration relative to the 'without development' baseline.
- 15.77 Application of micro-siting allowance has the potential to affect some of the data inputted to the SEPA Carbon Calculator as set out in **Appendix 15.1** as referenced previously, however such effects are likely to be limited and would not change the residual level of effect reported above.

Secondary mitigation or enhancement

15.78 No secondary mitigation or enhancement is required or has been identified.

Residual effect

15.79 In the absence of secondary mitigation, the residual effect is the same as that reported above in the pre-mitigation scenario.

Significance

15.80 This effect is considered to be **Significant**.

Limitations and Assumptions

15.81 To ensure transparency within the EIA process, the following limitations and assumptions have been identified.

- SEPA's Carbon Calculator methodology was developed for onshore windfarms on Scottish peatlands, however it is able to utilise input data that is specific to the scheme and site in question, as well as published benchmarks where such data is not available, and has been applied previously to onshore wind farm projects outside of Scotland including England and Wales. As a result, it is not considered that its application to the Project for Assessment results in any significant limitations; and
- The online version of the Scottish Environment Protection Agency (SEPA) Carbon Calculator tool (<https://informatics.sepa.org.uk/CarbonCalculator/>) was not available at the time of writing. A Microsoft Excel version (v 2.14.1) has therefore been used in lieu of the online version. This Excel tool version is considered to represent best practice and the most reasonable approach publicly available to estimate GHG emissions and savings from the Project for Assessment and its net GHG effect in line with ISEP GHG Guidance. It is acknowledged that an updated Carbon Calculator assessment may be necessary once the updated online version becomes available.

Summary

15.82 **Table 15.13** provides a summary of the effects, receptors, residual effects and conclusions of significance considered within the Chapter.

15.83 The table only provides a summary of the residual effects identified within the assessment and details of all primary, secondary and tertiary mitigation measures that have been taken into account are set out in detail within the Chapter and summarised in the Environmental Management Plan included in **Volume 3: Environmental Management Plan**.

Table 15.13: Summary of residual effects

Effect	Receptor	Residual effect	Is the residual effect Significant?
Construction Stage			
GHG emissions - construction stage	Global climate system	Moderate adverse	Yes
Operational Stage			

Effect	Receptor	Residual effect	Is the residual effect Significant?
GHG savings (annual) – operational stage	Global climate system	Moderate beneficial	Yes
Combination of construction, operational and decommissioning stages			
Net GHG effect – construction, operation & Decommissioning	Global climate system	Major beneficial	Yes

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